MSU Certification in College Teaching Institute

Creating Effective Learning Environments: Five Easy Steps to Peer Instruction

Learning goals:

1. Observe and describe the basic components or steps of peer instruction and the conceptual understanding behind the steps of peer instruction.
2. Describe the elements of good clicker questions; use these elements to analyze clicker questions;
3. Create your own clicker questions in your discipline, STEM or otherwise, and link them to the question cycle.
4. Begin to think about a plan to transform a short segment of a standard lecture into one that utilizes peer instruction and personal response.

Workshop activities:

1. (0-10) Worksheet Part A; Student response system: Polleverywhere – Go to https://pollev.com/bennettgoldberg or text BENNETTGOLDBERG to 37607 to start the poll; start with simple questions. Do one STEM, One non-STEM.
2. (10-20) Part of presentation on peer instruction, including videos from PI module, classroom observation;
3. (20-30) Worksheet Part B: The steps of peer instruction. Reasons behind peer instruction.
4. (30-40) Worksheet Part C: Analyze clicker questions, identify strengths and weaknesses, both in STEM and non-STEM
5. (40-50) Report out. Open discussion on how to improve clicker questions using Blooms Taxonomy.
6. (50-60) Practice with PI: Identify a person at each table to assist in the PI process during group discussions. Run a few clicker questions, first as standard questions, then on how to interact with groups.
7. (60-75) Worksheet Part D: Create clicker questions in your discipline. Start with a concept or idea, write answers and distractors, analyze within the context of Bloom's Taxonomy, and re-write towards a higher level of learning. Share with your group of three.
8. (70-80) Share out clicker questions created.
9. (80-90) Worksheet Part E: short report and then open discussion of challenges of implementation of peer instruction.

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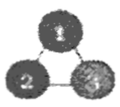
Part A: Introduction to clicker questions and peer-instruction.

This icon means answer as an individual. Commit to a response, express your current (pre) state of knowledge.



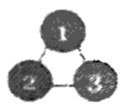
Articulate, debate, and revise: This icon means discuss and then agree (or sometime not) on an answer.

Let's do a few examples of clicker questions.

Part B:

Write down the steps of peer instruction that you observed in the videos.

1. Step One: Problem prompt
2. Step Two: Students think individually
3. Step Three: Students discuss answer
4. Step Four: Students gives new answer
5. Step Five (if necessary): Expert explanation



Compare your steps (four or five) with those of your neighbors. Reach consensus, identify one of you to report out.

Part C: Analyze clicker questions and improving clicker questions: When writing clicker questions, it is useful practice to analyze the question in terms of three ideas:

1. **Where in the learning cycle the question is focused?** Where in your class might the question best fit, or more appropriately, what types of questions do you want to use/develop for different parts of your class's learning cycle? See learning cycle below.
2. **What is the Bloom's Taxonomy level of the question?** If it is fact checking or memorization, it is unlikely to develop deeper or conceptual understanding, and unlikely to lead to engaging student discussion. Questions at higher Bloom's levels of comprehension or analysis require students to think more, talk more, and learn more. Refer to Bloom's Taxonomy below.
3. **Does the clicker question contain believable distractors?** Questions that include mistaken elements of common or prior knowledge or misconceptions in the possible answers are very effective at challenging student's to overcome their commonly held, but mistaken beliefs. This is a key part of the peer instruction process – requiring students to individually express an answer prior to discussion or expert solution forces them commit to a position.

On the next page are three questions. Working in groups, analyze with the criteria listed above. Think about the *kinds of discussions do these questions elicit in the students.*

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Newton's Third Law (Physics)

Which of these is Newton's Third Law?

A. For every action, there is an equal and opposite reaction.
B. A body at rest remains at rest unless acted upon by an unbalanced force.
C. The force between two bodies is proportional to their masses and inversely proportional to the square of the distance between them.
D. $F = ma$

1. Where might this come in the question cycle?

2. To what level of knowledge on Bloom's taxonomy is the question directed?

3. Are the distractors good? Bad? What type of discussion would this question engender?

Performances of gender and/or sexuality appear throughout *Middlesex* as when

A. the Object plays Tiresias opposite Callie's Antigone.
B. Jerome plays Tiresius opposite the Object's vampire.
C. Callie plays Tiresius and later Cal plays Hermaphroditus.
D. Callie plays Antigone and later plays Ellie and her Electrifying Eeeel.

1. Students got this wrong (they are all correct). What is this question trying to test?

2. Where might this come in the question cycle?

3. To what level of knowledge on Bloom's taxonomy is the question directed?

4. Are the distractors good? Bad? What type of discussion would this question engender?

Writing Questions #3: Revise Existing Question

What causes the seasons?

A. The change in the earth's distance from the sun during the year
B. The tilt of the earths axis
C. Changes in the sun's brightness
D. Changes in clouds
E. None of the above

Can we make a better question on the SAME topic?
Yes...

1. Where might this come in the question cycle?
Before or after the material is seen

2. To what level of knowledge on Bloom's taxonomy is the question directed?
Knowledge (L1)

3. Are the distractors good? Bad? What type of discussion would this question engender?
Bad
A is good

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Great, now look at different versions of the same questions, shown below. Two ask the 'same' thing, but in a different way. The humanities question is a new one.

Let's analyze these versions of the questions in terms of Bloom's taxonomy, the distractors and the *kinds of discussions do these questions elicit in the students*

Thanks to Carrie Preston (BU); Stephanie Chasteen (CU) and Peter Newbury (UCSD)

Actions and Reactions (Physics)

If for every action there is an equal and opposite reaction, how does anyone win a tug-of-war?

A. The team with the larger mass requires a greater force to get moving so it beats the team with the smaller mass.
B. The team with better traction wins because they can push harder against the ground.
C. The team with the larger mass has a greater inertia so it is more difficult to move and so, it wins the tug-of-war.
D. The team with the smaller mass wins because it can get moving more quickly, pulling the heavier team forward.

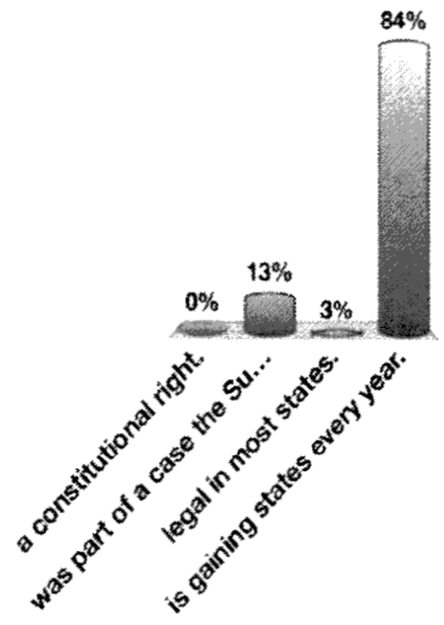
1. Bloom's taxonomy?

2. Distractors?

3. What type of discussion would this question engender?

Gay marriage in the U.S. is

A. a constitutional right.
B. was part of a case the Supreme Court refused to hear this year.
C. legal in most states.
D. is gaining states every year.



1. Students got this wrong. What is the correct answer? (This was in 2015)

2. Where might this come in the question cycle?

3. To what level of knowledge on Bloom's taxonomy is the question directed?

4. Are the distractors good? Bad? What type of discussion would this question engender? (this is a pretty good question)

At least one is good, since it got students to choose it, but the discussion would benefit from a greater diversity of "wrong" answers.

Better seasons example

What would happen to the seasons if the earth's orbit around the sun was made a perfect circle (but nothing else changed) ?

A. There would be no seasons
B. The seasons would remain pretty much as they are today
C. Winter to spring would differ much less than now
D. Winter to spring would differ much more than now

Much better question. Requires reasoning!

1. Bloom's taxonomy?

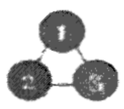
L4 - Analysis

2. Distractors?

3. What type of discussion would this question engender?

More discussion, what causes seasons needs to be more strongly believed in.

Part D: Think about a topic you that you recently taught or learned. On your own, write a draft question that addresses one of the pedagogical goals from the Question Cycle (see last page). Include 3-4 plausible distractors.



Share your question with your group of three or a neighbor. Try to identify the Bloom's level and type of pedagogical goals in the question cycle of the question your neighbor provide.

Part E: Write down the top three fears/challenges/barriers you think you will face in implementing peer-instruction in your future teaching:

1.

2.

3.

Share with your group your concerns, and discuss strategies for overcoming them. We will share out at this point.

Resources and credits below:

Question Cycle

Courtesy of Rosie Piller

Before Instruction

- **Motivate** students
  - Why is it important to…?
  - What might we want to…?
  - What kinds of things can go wrong?
- Help them **discover** information
  - What do we have to take into account when we…?
  - What needs to happen when you…?
  - Predict: Since X causes Y, what do you think will happen when…?
- Assess **prior knowledge** or **provoke** thinking/discussion
  - What do you think about…?
  - Would you/do you…?
  - What do you think will happen if…?

During Instruction

- Test **knowledge** of facts
  - What are the three types of…?
  - Can you define…?
- Test **comprehension** of concepts
  - Which statements support…?
  - What examples can you think of?
- Test **applications** of concepts
  - What would happen if…?
  - Which of the following are X?
- Help them **analyze** what they are learning
  - Based on the symptoms, what would you say is going on?
  - What is the relationship between…?
- Test their ability to **evaluate**
  - Here are two solutions. Which is more appropriate and why?
  - Which of these is more important?
- Provoke them to **synthesize** their understanding.
  - How would you test…?
  - Propose a way to…
- Elicit a **misconception**
  - Ask questions where a common student misconception will result in a particular response
- Exercise a **skill**
  - How would you…?
  - What is the next step in this problem?

After Instruction

- Have students **recap** what they have learned
  - What steps did you go through to solve the problem?
  - What are the most important things to remember?
  - Exit poll: What did we learn today?
- Ask them to relate information to the **big picture**
  - How does this lead into the next topic?
- Demonstrate **success** and **limits** of understanding
  - Ask questions that students have built an understanding of during the class.
  - Ask questions that go beyond what was done in class

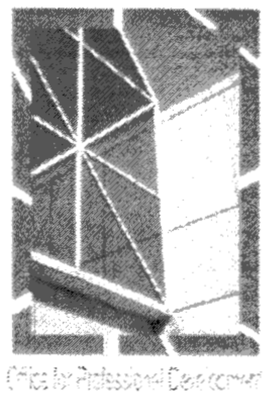
[1] *Rosie Piller, Making Students Think: The Art of Questioning. Short papers published in: Computer Training & Support Conference, 1995; ISPI International Conferences, 1991 and 1996; ASTD National Conference on Technical & Skills Training, 1990. Related workshop description at http://www.educationexperts.net/mstworkshop.html.*

Bloom's Taxonomy, left to right…

Knowledge	*Comprehension*	*Application*	*Analysis*	*Evaluation*	*Synthesis*
know	restate	translate	distinguish	compose	judge
define	discuss	interpret	analyze	plan	appraise
memorize	describe	apply	differentiate	propose	evaluate
list	recognize	employ	calculate	design	compare
recall	explain	demonstrate	experiment	assemble	value
name	identify	dramatize	compare	construct	select
relate	locate	practice	contrast	create	choose
illustrate	criticize	design	assess		
operate	solve	organize	estimate		
	examine	manage	measure		

Web References for Blooms:

- http://www.coun.uvic.ca/learn/program/hndouts/bloom.html
- http://www.fwl.org/edtech/blooms.html
- http://apu.edu/~bmccarty/curricula/mse592/intro/tsld006.htm
- http://152.30.11.86/deer/Houghton/learner/think/bloomsTaxonomy.html
- http://amath.colorado.edu/appm/courses/7400/1996Spr/bloom.html
- http://www.stedwards.edu/cte/bloomtax.htm
- http://quarles.unbc.edu/lsc/bloom.html
- http://www.wested.org/tie/dlrn/blooms.html
- http://www.bena.com/ewinters/bloom.html
- http://weber.u.washington.edu/~krumme/guides/bloom.html



References:
Anderson, L. W. & Krathwohl, D. R. (2001). A Taxonomy for learning, teaching, and assessing.
Bloom, B. S. (Ed.). (1956). Taxonomy of educational objectives: The classification of educational goals, by a committee of college and university examiners. New York: Longmans.
John Maynard, University of Texas, Austin
Marilla Svinicki, University of Texas, Austin

Resources for Peer Instruction:

General resources:

http://www.cwsei.ubc.ca/resources/clickers.htm excellent site with access to many clicker resources.
http://www.colorado.edu/sei/fac-resources/workshops-clickers-materials.htm is a great resource for faculty on training to use clickers.
http://blog.peerinstruction.net/ is the official peer instruction site from Julie Schell.
https://www.peerinstruction.net/ is a network of peer instruction users.
http://blog.sciencegeekgirl.com/ is Stephanie Chasteen's site, with lots of info from her workshops on clickers and peer instruction.
http://cft.vanderbilt.edu/guides-sub-pages/clickers/ Derek Bruff's page at Vanderbilt on Clickers and how to use them.
http://www.peerinstruction4cs.org/ Peer instruction for computer science.

https://ctd.ucsd.edu/services/peer-instruction-with-clickers/ Peter Newbury and UCSD's site on peer instruction using clickers. Like CWSEI, nice videos on peer instruction.
http://perusersguide.org/guides/Section.cfm?G=Peer_Instruction&S=Resources Good site on peer instruction in physics.

Example clicker questions:

http://www.cwsei.ubc.ca/resources/files/ClickerWorkshopMaterials/Example-questions-big-v3.pptx is a great resource of example clicker questions from Stephanie Chasteen.
http://www.cwsei.ubc.ca/resources/clickers.htm#questions has links to a wide variety of clicker question repositories from CU Boulder and UBC Science Education Institute.
http://www.colorado.edu/physics/EducationIssues/cts/index.htm lots and lots of physics concept tests (clicker questions).
http://www.physics.umd.edu/perg/role/PIProbs/ProbSubjs.htm more physics clicker questions from Joe Reddish at UMD.